A NEW FAMILY OF MIOCENE SALAMANDERS FROM THE TEXAS COASTAL PLAIN[1]

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Miocene urodele remains from North America are apparently quite rare in collections. Only two finds have been reported. Sirenid vertebrae are available from the Lower Miocene of Florida (Goin and Auffenberg, 1955), and a large skull is known from the Middle Miocene of Texas (Taylor and Hesse, 1943). Thus a number of large vertebrae now available from Lower and Middle Miocene deposits of the Texas Coastal Plain are of considerable interest. There is reason to believe that these vertebrae are to be referred to the same species as that described by Taylor and Hesse. Most fossil salamanders have been described on the basis of vertebrae; these are the most common elements and their characters are known to be as diagnostic and less variable than most cranial elements. For this reason the vertebral elements from the Texas Coastal Plain are described below. Unfortunately, the skull described by Taylor and Hesse was not associated with any vertebrae, though some of the vertebral elements described below originate from the same formation and the same general area.

The skull (Museum A. and M. College of Texas, No. 2234) described by Taylor and Hesse (1943) was designated as the type of a new genus and species, *Batrachosauroides dissimulans*. The specimen was collected 3 miles northwest of Coldspring, San Jacinto County, Texas, Fleming formation, Hemigfordian Age (see Quinn, 1955 and Wilson, 1956, 1957 for a discussion of the stratigraphic relations of fossil beds in the Texas Miocene).

The generic characters of *Batrachosauroides* follow (*fide* Taylor and Hesse, *op cit.*); " . . . an elongated premaxillary spine which separates the nasals; bony pterygoids; the frontals and to a lesser extent, other dorsal anterior cranial elements, sculptured; the occipital condyles with a convex surface apparently somewhat stalked and rather widely separated; premaxilla single, toothed; toothed maxilla-

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ries present; vomerine teeth present; mandible articulartion by a ball and socket joint, the ball being the ossified articulare."

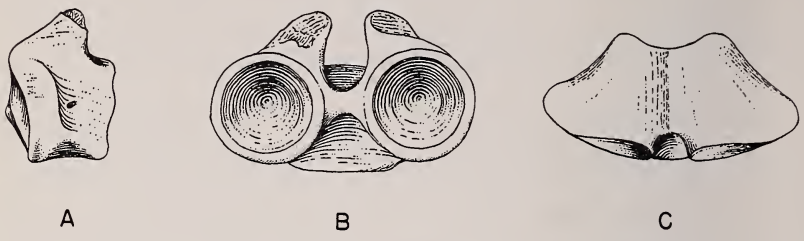

Figure 1. University of Texas, Bureau of Econ. Geol., Vert. Pal. Coll., No. 31057. Atlas referred to *Batrachosauroides dissimulans*, Polk County, Texas, Middle Miocene. A.—Lateral view. B.—Anterior view. C.—Ventral view.

On the basis of the skull the systematic position of *Batrachosauroides* is not definitely established. However, based on characters afforded by the type, it seems reasonable to refer the genus to the suborder *Salamandroidea* Noble, at least tentatively. A number of structural characters will separate it from the other subordinal groups of the urodeles.

The familial relationships are even less clear. Taylor and Hesse contended that of the three families of the Salamandroidea, *Batrachosauroides* was probably closer to the Amphiumidae than to either the Plethodontidae or the Salamandridae. This contention was based on the presumed absence of opisthocoelous vertebrae, separating it from the Salamandridae; and the presence of parasphenoid and splenial teeth, separating it from the Plethodontidae.

The skull suggests a salamander the size of *Amphiuma*. The sculpturing of the anterior skull bones, presence of a temporal ridge and the general disposition and shape of the various cranial elements in the fossil are all characters found in *Amphiuma*. However, the skull of *Batrachosauroides* was said to differ from that of *Amphiuma* in possessing a well developed series of splenial teeth. Unfortunately, the presence or absence of an ethmoid, a feature peculiar to the Amphiumidae, cannot be determined in the fossil.

Apparently no vertebrae were collected with the type, so that it is difficult to see how Taylor and Hesse determined that the vertebrae were amphicoelous and not opisthocoelous. All of the Salamandridae and some of the Plethodontidae are known to possess opistho-

coelous vertebrae, though the condition seems to have a different structural basis in each family (Soler, 1950). Numerous vertebrae, tentatively referred to *Batrachosauroides dissimulans*, are now available. These are all strongly opisthocoelous. They belong to a large species of salamander found in the same bed as that of the type skull. No other salamander vertebrae are known from these, or associated beds. In the absence of articulated material the reference of these vertebrae to the same genus and species as that of the type seems reasonable.

In the generic description of *Batrachosauroides* and in the discussion of relationships Taylor and Hesse state that the premaxillaries are single, yet in the description of the separate elements they state that the premaxillary " . . . may . . . have been in two parts originally." However, they go on to state that "Closer scrutiny . . . points to the greater probability that it is a fractured single element." If the premaxillary was double in life and the vertebrae are correctly referred, the two most important characters used to separate *Batrachosauroides* from the Salamandridae become points of similarity rather than points of dis-similarity.

Sculpturing of the cranial elements is found in at least some individuals in certain salamandrid genera (*Salamandrina*, etc.) and some Plethodontidae (*Aneides, Manculus*), so that this character is not peculiar to the Amphiumidae among the Salamandroidea.

By sectioning one of the fossil vertebrae it has been possible to show that the opisthocoelous condition of the fossils is similar to that described as hemicoelously opisthocoelous by Soler (*op cit.*), *i.e.*; like that in the Desmognathinae among the Plethodontidae, rather than like that in the Salamandridae.

Several atlantes referred to *Batrachosauroides* are available from the Texas Coastal Plain Miocene. They are quite simple (fig. 1), unlike the more complex elements of the Plethodontidae, but more similar to those of the Salamandridae and Amphiumidae.

On the basis of the above it is fairly obvious that *Batrachosauroides dissimulans* cannot clearly be placed in any of the existing families of the Salamandroidea, or, for that matter, in any recent urodelian family. It is here suggested that the fossil form be considered representative of a new family of salamanders, now extinct, but known to exist in at least the Miocene of North America.

Order *URODELA*

Suborder Salamandroidea

Family batrachosauroididae n. fam.

Diagnosis.—*Skull*: Differs from the Salamandridae and Plethodontidae, but not the Amphiumidae, in possessing a well developed median parietal ridge. In addition, it differs from the Plethodontidae in being provided with pterygoids and splenial teeth in the adult. From the Salamandridae it further differs in possessing (presumably) a single premaxillary. From the Amphiumidae it differs in possessing splenial teeth. From the Desmognathinae among the Plethodontidae it also differs in possessing a prefrontal and lacking parasphenoid teeth. *Vertebrae*: The atlas differs from that of the Plethodontidae in lacking the small posteriorly directed basipophysial processes found in this element in *Batrachosauroides*. Furthermore, the ventral surface of the centrum is more or less horizontal when viewed from the side, not directed downwards posteriorly as in the Plethodontidae. The centrum is considerably shorter than that in the Plethodontidae and the Salamandridae, and lacks the large paired subcentral nutritive foramina found in the Amphiumidae. In general outline the atlas is more similar to those found in the Cryptobranchoidea and Proteida than to those found in the genera of Salamandroidea.

The dorsal vertebrae differ from those of the Amphiumidae and most Plethodontidae in being opisthocoelous, in which the anteriorly directed condyle is osseous. From the Salamandridae the vertebrae of the fossil differ in being hemicoelously opisthocoelous, rather than pseudocoelously opisthocoelous. From the Desmognathinae among the Plethodontidae it differs chiefly in lacking the posteriorly directed "pterypophysial"-like processes arising from the dorsal surfaces of the postzygapophyses of the anterior dorsal vertebrae. From the Amphiumidae the fossil vertebrae also differ in lacking the small pair of anteriorly directed accessory basipophysial processes found in this family on the antero-ventral edge of the centrum. In addition to the above, the transverse process is located more posteriorly than it is in any of the presently recognized families of the Salamandroidea, being more similar to those found in the Cryptobranchoidea and Proteida.

An additional diagnostic character of considerable interest is the large size of the fossil form, separating it from all known definite

Plethodontidae and Salamandridae, either fossil or Recent. *Batrachosauroides* presumably attained a length of three feet.

A number of Miocene salamanders are known from Europe. Most of these are clearly salamandrids, similar to *Batrachosauroides* only in possessing opisthocoelous vertebrae, but obviously not closely related to the North American form. *Dehmiella* is currently considered a Miocene Plethodontid from Europe, though it seems abberant in certain regards. Regardless of the final nomenclatorial assignment for this and several other somewhat problematical fossil genera it is significant for purposes of this paper that it differs from *Batrachosauroides* in a number of important vertebral characters. In addition, several species of *Megalobatrachus* (Cryptobranchoidea) are known from the European Miocene, all of which differ from *Batachosauroides* in cranial and/or vertebral characters. A single specimen of an Oligocene salamandrid (*Paleotaricha*) is known from North America. It also differs markedly from the Texas Miocene genus. From what information is available it appears that no other fossil or Recent genus of Urodele clearly bears a close relationship to *Batrachosauroides.* As far as is presently known the family Batrachosauroididae contains only the type genus. The removal of *Batrachosauroides* from a problematical position in the Amphiumidae leaves the latter with a fossil history extending back to but the Pleistocene of Florida.

The possibility still exists that the large vertebrae from the Miocene of the Texas Coastal Plain are not to be referred to *Batrachosauroides.* If in the future this is found to be the case the family should be found to be valid on cranial characters alone, and the vertebrae, being quite distinctive, should form the basis of the description of a new genus and species of salamander, presumably familially removed from all other known salamandroids, both fossil and Recent. A full description of the vertebrae referred to *Batrachosauroides dissimulans* follows. It is based on 18 vertebrae from several fossil sites in eastern Texas.

The vertebrae obviouly represent a number of individuals. In centrum length they vary from 8.5 to 15.1 mm. Some are quite eroded and/or broken. In the remaining better specimens relatively little variation is discernible, except as follows: In the more anterior vertebrae the centrum is shorter in proportion to its width; the transverse process is directed slightly more dorsally and the hypapophysial keel is more ridge-like and better developed (with

the exception of the first few vertebrae following the atlas-axis complex, where the keel is evidently flattened). The anterior portion of the base of the transverse process arises closer to the condylar lip. The neural spine appears to be thicker and the size of the neural canal is proportionately larger than in the more posterior vertebrae.

A typical dorsal vertebra is described below (University of Florida 2013) and illustrated in figure 2.

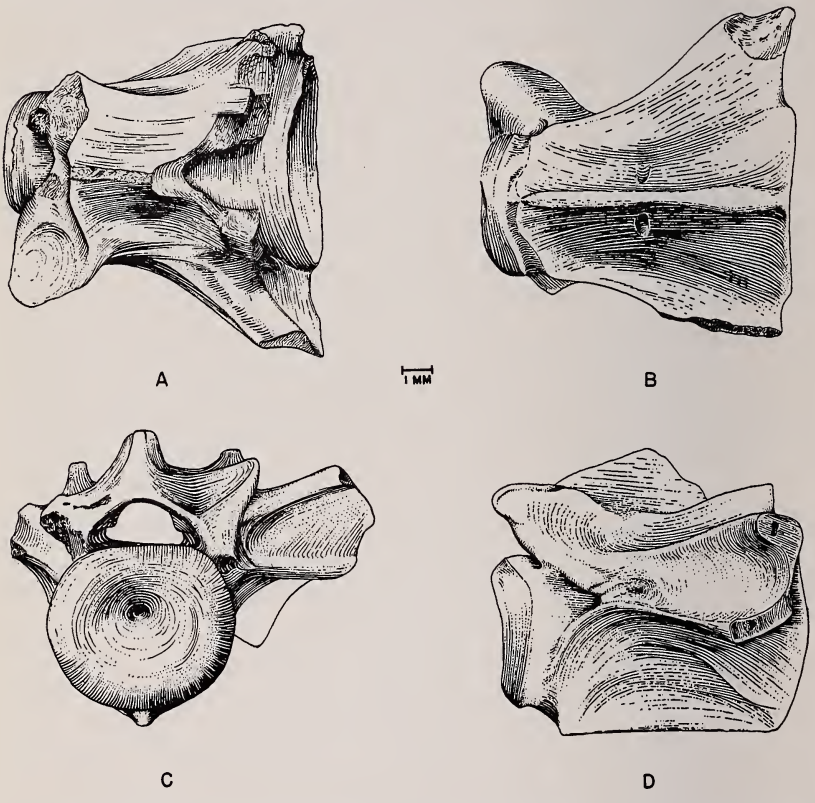

Figure 2. University of Florida, Vert. Foss. Coll., No. 2013. Dorsal vertebra referred to *Batrachosauroides dissimulans*, San Jacinto County, Texas, Middle Miocene. A.—Dorsal view. B.—Ventral view. C.—Anterior view. D.—Lateral view.

U.F. 2013—a large, opisthocoelous dorsal vertebra. Measurements (in mm.): length of centrum along mid-ventral line, 12.3; width of vertebra at narrowest part of the zygapophysial ridges,

8.3; height of vertebra from lower margin of the centrum to a line drawn between the facets of the prezygapophyses, 11.0. Centrum longer than high; glenoid cavity and cotyle rounded; notochordal canal well defined in the center of the cotyle; condyle well developed, with a rounded depression in the center; centrum provided with a ridge-like median hypapophysial keel, nearly straight when viewed from the side, on either side of which is one foramen; length of neural arch greater than the width of the centrum, and its width at the narrowest part of the zygapophysial ridges slightly greater than the width of the centrum. Neural canal slightly depressed when viewed from the front, and provided with a well developed median epipophysial ridge on its floor; articulating surfaces of the left prezygapophyses oval, but eroded, longer than wide, directed slightly more laterally than anteriorly when viewed from above; zygapophysial ridges not well developed, rounded; transverse process well developed, with two articular surfaces, the upper and lower laminae connected by a bony vertical septum, articular surfaces nearly even with the posterior edge of the centrum.

Unfortunately the posterior portion of the neural arch is broken away in all of the specimens available for study.

Material examined includes the following:

University of Florida Collections, No. 2013, one vertebra, Burkeville fauna location, Moscow locality, San Jacinto County, Texas, Fleming formation, Early Hemingfordian Age, Middle Miocene.

University of Texas, Bureau of Econ. Geol., Vert. Pal. Collections, Nos. 31057-120, three vertebrae, 31057-57, two vertebrae and 31057-94, one vertebra and 31057-94, one vertebra, all from Site 1, Polk County, Texas, Fleming formation, Early Hemingfordian Age, Middle Miocene; 31057, seven vertebrae, data "Polk County, Texas"; 31057-17, two atlantes, data "Polk County, Texas"; 40067-38, one vertebra, Hidalgo Bluff Locality, Texas, Lower Oakville formation, Arikareean Age, Lower Miocene; 40067-100, two vertebrae, one of which is very fragmentary, Hidalgo Bluff Locality, Texas, Lower Oakville formation, Arikareean Age, Lower Miocene. In addition two vertebrae obviously belonging to *Batrachosauroides dissimulans,* but without data or catalog numbers are in the University of Texas Bureau of Economic Geology Paleontological Collections. On the basis of the locality data the genus is known only from Lower and Middle Miocene deposits of Texas.

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